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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 C.F.R. § 1.53(b))

Attorney Docket No.	SIM014
First Inventor or Application Identifier	Tue Nguyen
Title	Visual Indicator Trapping System
Express Mail Label No.	

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: **Assistant Commissioner for Patents, Box Patent Application, Washington, DC 20231**

1. [X] * Fee Transmittal Form *(e.g., PTO/SB/17)* *(Submit an original and a duplicate for fee processing)*
2. [X] Specification [*Total Pages* 16]
   (preferred arrangement set forth below)
   - Descriptive title of the Invention
   - Cross References to Related Applications
   - Statement Regarding Fed sponsored R & D
   - Reference to Microfiche Appendix
   - Background of the Invention
   - Brief Summary of the Invention
   - Brief Description of the Drawings *(if filed)*
   - Detailed Description
   - Claim(s)
   - Abstract of the Disclosure
3. [X] Drawing(s) *(35 U.S.C. 113)* [*Total Sheets* 4]
4. Oath or Declaration [*Total Pages* 2]
   a. [X] Newly executed (original or copy)
   b. [ ] Copy from a prior application (37 C.F.R. § 1.63(d)) *(for continuation/divisional with Box 16 completed)*
      i. [ ] DELETION OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b)

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ACCOMPANYING APPLICATION PARTS

7. [X] Assignment Papers (cover sheet & document(s))
8. [ ] 37 C.F.R.§3.73(b) Statement *(when there is an assignee)* [ ] Power of Attorney
9. [ ] English Translation Document *(if applicable)*
10. [X] Information Disclosure Statement (IDS)/PTO-1449 [ ] Copies of IDS Citations
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13. [X] * Small Entity Statement(s) *(PTO/SB/09-12)* [ ] Statement filed in prior application, Status still proper and desired
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Name	Tue Nguyen				
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Name (Print/Type)	Tue Nguyen	*Registration No. (Attorney/Agent)*	
Signature		*Date*	6/7/00

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STATEMENT CLAIMING SMALL ENTITY STATUS (37 CFR 1.9(f) & 1.27(c))--SMALL BUSINESS CONCERN

Docket Number (Optional)
SIM014

Applicant, Patentee, or Identifier: Tue Nguyen
Application or Patent No.:
Filed or Issued:
Title: Visual Indicator Cold Trapping System

I hereby state that I am
- ☐ the owner of the small business concern identified below:
- ☒ an official of the small business concern empowered to act on behalf of the concern identified below:

NAME OF SMALL BUSINESS CONCERN Simplus System Corporation

ADDRESS OF SMALL BUSINESS CONCERN 40737 Encyclopedia Circle, Fremont, CA 94538

I hereby state that the above identified small business concern qualifies as a small business concern as defined in 13 CFR Part 121 for purposes of paying reduced fees to the United States Patent and Trademark Office. Questions related to size standards for a small business concern may be directed to: Small Business Administration, Size Standards Staff, 409 Third Street, SW, Washington, DC 20416.

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If the rights held by the above identified small business concern are not exclusive, each individual, concern, or organization having rights in the invention must file separate statements as to their status as small entities, and no rights to the invention are held by any person, other than the inventor, who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person made the invention, or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d), or a nonprofit organization under 37 CFR 1.9(e).

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- ☐ each such person, concern, or organization is listed below.

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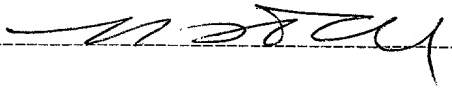
NAME OF PERSON SIGNING Tue Nguyen

TITLE OF PERSON IF OTHER THAN OWNER President

ADDRESS OF PERSON SIGNING 496 Olive Ave., Fremont, CA 94539

SIGNATURE  DATE 6/7/2000

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Visual indicator cold trapping system

Invented by

Tue Nguyen

Craig Alan Bercaw

Visual indicator cold trapping system

Field of the invention

The present invention relates generally to apparatus for processing of a semiconductor wafer, and more particularly to a cold trapping system with a visual indicator to allow monitoring the adequacy of the cold trap.

Background of the invention

Semiconductor processes use vapor precursors for processing of thin films on an integrated circuit (IC) substrate. The majority of these vapor precursors, together with their by-products are pumping out and exhausted to a waste stream.

It is very expensive to collect and dispose of the precursor exhaust products. Further, these non-reactive precursors and these byproducts can be hazardous and harmful to the environment. The IC industry is forced to conform to ever more stringent regulations concerning the storage and disposal of these wastes.

It is very inconvenient to collect waste as a gas because it is difficult to transport and bulky to store. It is more convenient if the waste can be converted, at least partially into a solid or liquid waste. It is well known to use cold traps to completely condense some chemical vapors. It is also well known to use cold traps to condense elements of a precursor to at least simplify the waste collection process.

In a chemical vapor deposition (CVD) process, high temperature process is often used. Because of the low efficiency of the CVD process, a hot trap is recommended for completing the CVD reaction, leaving only the by-products to the exhaust stream. An example is copper CVD process. Copper CVD process

uses copper-hfac-tmvs precursor to deposit copper on a hot surface (~200°C) following the reaction:

$$2\ \text{Cu-hfac-tmvs} \rightarrow \text{Cu} + \text{Cu(hfac)}_2 + 2\ \text{tmvs} \quad (\text{at} > \sim 100°\text{C})$$

The reaction occurs at temperature higher than ~100°C. The efficiency of this reaction is roughly 10-20%, thus 80-90% of the precursor leaves the process chamber un-reacted. A cold trap would then collect the precursor Cu-hfac-tmvs, and the by-products $Cu(hfac)_2$ and tmvs. Using a hot trap before the cold trap, most of the precursor would further reacts, leaving only the by-products in the waste stream.

Fig. 1 shows a prior art apparatus for a cold trap. The precursor exhaust enters the cold trap at the cold trap input 23, converting some elements of the exhaust into non-gaseous phase at the waste collection surface 15, and exhaust the gaseous phase to the cold trap output 25. The cooler means 37 serves to cool the waste collection surface 15 to a trapping temperature where the precursor exhaust reacts and separates into non-gaseous and gaseous components. The non-gaseous components trapping at the waste collection surface 15 could travel to the waste drain collection 45. The waste collection 45 has a drain valve 43 to keep the waste stored.

The major disadvantage of this prior art is the inability to quickly evaluate the adequacy of the cold trap. If the cold trap is not efficient enough, material can travel downstream of the cold trap and might deposit outside of the cold trap. If there is some problem upstream of the cold trap, such as a cold section of the pipe leading to the cold trap, material can deposit outside of the cold trap.

A co-application titled "*High pressure chemical vapor trapping system*" of the same author, Tue Nguyen, provides a high pressure trapping system composing of a hot trap for completing the reaction and a cold trap for trapping the residue.

Fig. 2 shows the high pressure chemical vapor trapping system. The exhaust from the processing chamber 110 is pumped away by the vacuum pump 130. The pressure in the process chamber foreline 115 is normally low, in the range of torr or millitorr pressure. After the vacuum pump, the pressure is almost atmospheric at the vacuum pump exhaust 135. The hot trap 120 converts un-reacted precursors to the precursor by-products, and the cold trap 140 converts the gas phase by-products to non-gaseous phase by-products for easily transport and storage. This system connects to the downstream of the vacuum pump to take advantage of the high pressure at the pump exhaust. By not disturbing the chamber configuration, there is no potential contamination of the process. Using this system, there is no observable degradation to the vacuum pump, and no contamination to the process chamber.

There is no visual indicator to show whether or not the hot trap is converting all reaction elements, and there is no visual indicator that the cold trap is trapping all waste elements.

It would be advantageous if there is a visual indicator allowing the monitoring of the adequacy of the cold trap.

Summary of the invention

Accordingly, a visual indicator cold trapping system to allow monitoring the adequacy of the cold trap is provided. The system comprises a cold trap having an input port, a output port, a waste collection surface, a cooler means to cool

the trap to a temperature in the range from 25 degrees to minus 200 degrees Celsius. The cold trap provides non-gaseous wastes at the waste collection surface, and gaseous exhaust at the gas output port. For visual indicator, the cold trapping system comprises a plurality of hollow transparent connectors.

In some aspects of the invention, the hollow transparent connector is connected to the input of the cold trap. Its transparency property allows the visual inspection of the cold trap for any material deposited there. Any material deposited in this transparent connector implies that there is problem upstream of the cold trap. Since there is material deposited in the connector section, it is likely that there is also material deposited in the pipe upstream of the cold trap. The visual indicator allows the problem to be spotted immediately and to alert the operator to take appropriate actions. In some aspects of the invention, the transparent connector has a heater means to bring its temperature to be the same as the upstream pipe. This allows the connector to be at the same temperature as the upstream pipe, thus eliminates the possibility of material deposition due to temperature difference. In some aspects of the invention, the input of the cold trap has a transparent section, served as the connector itself.

In some aspects of the invention, the hollow transparent connector is connected to the output of the cold trap. Any material deposited in this transparent connector implies that there is problem downstream of the cold trap. Since there is material deposited in the connector section, there is likely that there is material exhausted from the cold trap without being trapped there. In some aspects of the invention, the transparent connector has a heater means to bring its temperature to be the same as the downstream pipe. This allows the

connector to be at the same temperature as the downstream pipe, thus eliminates the possibility of material deposition due to temperature difference.

In some aspects of the invention, the visual indicator cold trapping system further comprises a waste drain with a hollow transparent connector. In some aspects of the invention, the drain section is transparent to allow visual inspection of the collected material.

In other aspects of the invention, a high pressure chemical vapor trapping system to separate and collect elements of a chemical vapor exhaust with a visual indicator cold trap is provided. The system comprises a hot trap and a visual indicator cold trap connected to each other as a single unit. The exhaust pump is upstream of the trapping system, providing a high pressure in the hot trap.

The present invention system comprises a hot trap having an input port, a gas output port, a waste collection surface, and a heater. The heater heats the hot trap to a temperature in the range from 100 to 500 degrees Celsius. The hot trap accepts chemical vapor such as the above-described copper precursors and provides non-gaseous wastes at the waste collection surface, and gaseous exhaust at the gas output port at a pressure substantially the same as the input pressure.

The system also comprises a visual indicator cold trap having an input port operatively connected to the gas output port of the hot trap, a gas output port, a waste collection surface, and a plurality of hollow transparent connectors operatively connected to the ports of the cold trap. The cold trap cools the chamber to a temperature in the range from 25 degrees to minus 200 degrees

Celsius. The cold trap provides non-gaseous wastes at the waste collection surface, and gaseous exhaust at the gas output port at a pressure substantially the same as the input pressure. In this manner, vapor byproducts are collected in two stages. The visual indicator allows the determination of the adequacy of the trapping system. If the hot trap is not adequate, meaning allowing waste elements to escape the hot trap, the waste elements will show up at the visual indicator at the input of the cold trap. If the cold trap is not adequate, meaning allowing waste elements to escape the cold trap, the waste elements will show up at the visual indicator at the output of the cold trap. In some aspects of the invention, the cold trap further comprises a drain section for waste storage. The drain section also comprises a visual indicator for visual inspection.

The invention also provides that an exhaust pump, operatively connected to hot trap input port, provides gaseous exhaust to the hot trap. In this manner, a high pressure is created at the hot trap gas input port.

In some aspects of the invention, the chemical vapor exhaust is a MOCVD precursor such as Cu(hfac) combined with a ligand (Cu(hfac)L). Then, the first chamber includes a plurality of metal plates, or other heated structures extending into the hot trap. These metal plates are of the same metal as in the MOCVD precursor and act as metal collection surfaces. That is, the collection surface acts as the heater in the hot trap. As the precursor vapor is heated, metal from the precursor is deposited on the metal plates as the heat completes the chemical reaction. The metal collection surface/heaters are reclaimed from recycling when a predetermined amount of solid metal waste is collected on the collection surfaces.

In some aspects of the invention, the both the hot and cold chambers are easily removable for efficient recycling of the collected waste materials. A first exhaust line extends to the exhaust input port of the hot trap. The first line including at least one valve to block the passage of gas from the deposition chamber. Likewise, a second exhaust line extends from the hot trap gaseous exhaust port, and also includes at least one valve to block the escape of gas from the second line.

The hot trap includes a first valve at the exhaust input port and a second valve at the gaseous exhaust port. The hot trap is removable from the first and second lines for waste removal, when full. In this manner, the first and second valves in said hot trap prevent exhaust from escaping from the trap, when the trap is disconnected. The valves in the first and second lines prevent the escape of exhaust from the system when the hot trap is removed. In the same manner, valves are used in the gas lines going to and from the cold trap, and also used in the input and output gas ports. Then, the cold trap is also easily removable without allowing the escape of vapors from the system.

Sometimes the hot trap collection surfaces are biased with a voltage, whereby charged metal from the MOCVD precursor is attracted and deposited on said collection surface. In other aspects of the invention, the hot trap includes a second input port to accept a catalyst selected from the group consisting of water, alcohol, and ammonia, whereby the catalyst furthers the chemical reaction in the first chamber.

Brief description of the drawings

Fig. 1 shows a prior art cold trap.

Fig. 2 shows the co-application invention of the high pressure chemical vapor trapping system.

Fig. 3 shows the present invention of the visual indicator cold trapping system.

Fig. 4 shows the present invention of the high pressure chemical vapor trapping system using the visual indicator.

Detail description of the preferred embodiment

Fig. 3 shows the present invention of the visual indicator cold trapping system. There are 3 visual indicators, visual indicator 263 at the input port 223 of the cold trap, visual indicator 265 at the output port 225 of the cold trap, and visual indicator 275 at the drain port of the cold trap. The visual indicators 263 and 266 have optional heater means 264 and 266 to keeping the ends of the visual indicators at the same temperature as the incoming and outgoing pipe connection. The input port 223 brings the chemical vapor exhaust to the waste collection surface 215 to collect the non-gaseous element of the chemical vapor exhaust. The gaseous element will leave the cold trap at the output port 225. The cooler means 237 cools the waste collection surface to the trapping temperature, where the chemical vapor exhaust reacts and converts to non-gaseous element. The drain section 245 collects all the waste with the drain valve 243 to prevent waste vapor from escaping.

Fig. 4 shows the present invention of the high pressure chemical vapor trapping system using the visual indicator. The cold trap of the trapping system has an input visual indicator 363 and an output visual indicator 365. Input visual indicator 363 allows the determination of the adequacy of the hot trap,

and the output visual indicator 365 allows the determination of the adequacy of the cold trap.

What is claimed is:

1. A visual indicator cold trap apparatus comprising:
   a) a cold processing chamber comprising:
      - an input port;
      - an output port;
      - a waste collection surface;
   b) a cooler means to cool the processing chamber to a trapping temperature;
   c) a plurality of hollow transparent connectors operatively connected to the ports of the cold processing chamber;

   whereby the cold processing chamber accepts chemical vapor exhaust at the input port to further a chemical reaction, and provides non-gaseous wastes from the chemical vapor exhaust at the waste collection surface, and gaseous exhaust at the output port, and the hollow transparent connectors allows the visual inspection of the adequacy of the cold processing chamber.

2. A visual indicator cold trap apparatus as in claim 1 further comprising heater means for heating the input section of hollow transparent connectors to prevent material trapping outside of the connectors.

3. An improved cold trapping system apparatus as in claim 1 in which the trapping temperature is in the range from 25 to -200 degrees Celsius.

4. A visual indicator cold trap apparatus as in claim 1 in which a hollow transparent connector is operatively connected to the input port of the cold processing chamber, whereby a visual indication of material collected at the

transparent connector shows that there is a problem at the upstream flow of the cold trap.

5. A visual indicator cold trap apparatus as in claim 1 in which a hollow transparent connector is operatively connected to the output port of the cold processing chamber, whereby a visual indication of material collected at the transparent connector shows that there is a problem at the downstream flow of the cold trap.

6. A visual indicator cold trap apparatus as in claim 1 in which the input port of the cold processing chamber is transparent and the hollow transparent connector operatively connected to the input port is the transparent input port itself.

7. A visual indicator cold trap apparatus as in claim 1 in which the output port of the cold processing chamber is transparent and the hollow transparent connector operatively connected to the output port is the transparent output port itself.

8. A visual indicator cold trap apparatus as in claim 1 in which the cold processing chamber further comprises a drain port to collect the waste material.

9. A visual indicator cold trap apparatus as in claim 8 in which a hollow transparent connector is operatively connected to the drain port of the cold processing chamber, whereby a visual indication of material collected at the transparent connector shows that there is material collected at the cold trap.

10. A visual indicator cold trap apparatus as in claim 8 in which the drain section of the cold processing chamber is transparent, whereby a visual indication of material collected at the transparent section shows that there is material collected at the cold trap.

11. A high pressure chemical vapor trapping system to separate and collect elements of a chemical vapor exhaust having a visual indicator cold trap, the system comprising:

a) a first processing chamber having a first chamber input port, a first chamber gas output port, a first chamber waste collection surface, and a chamber heater to heat the first processing chamber to a first temperature, the first processing chamber accepting chemical vapor exhaust at the first chamber input port at a trapping pressure to further a chemical reaction, and providing non-gaseous wastes at the first chamber waste collection surface, and providing gaseous exhaust at the first chamber gas output port; and

b) a second processing chamber having a second chamber input port operatively connected to the first chamber gas output port, a second chamber gas output port, a second chamber waste collection surface, a second chamber cooler to cool the second processing chamber to a second temperature, less than the first temperature, and a plurality of hollow transparent connectors operatively connected to the ports of the second processing chamber,

whereby the second processing chamber accepting chemical vapor exhaust at the second chamber input port to further a chemical reaction, and providing non-gaseous wastes at the second chamber waste collection

surface, and gaseous exhaust at the second chamber gas output port, whereby vapor byproducts are collected in two stages, and the hollow transparent connectors allows the visual inspection of the adequacy of the cold processing chamber.

12. A high pressure trapping system as in claim 11 in which the first processing chamber first temperature is in the range from 100 to 500 degrees Celsius and in which the second processing chamber second temperature is in the range from 25 degrees to minus 200 degrees Celsius.

13. A high pressure trapping system as in claim 11 wherein the chemical vapor exhaust is a MOCVD precursor, in which said first processing chamber collection surface is biased with a voltage, whereby charged metal from the MOCVD precursor is attracted and deposited on the collection surface.

14. A high pressure trapping system as in claim 13 wherein the bias voltage is in the range from -10 to -100 volts DC, whereby positively charged metal from the MOCVD precursor is attracted and deposited on the collection surface.

15. A high pressure trapping system as in claim 13 wherein the bias voltage is in the range from 10 to 100 volts DC, whereby negatively charged metal from the MOCVD precursor is attracted and deposited on the collection surface.

16. A low pressure trapping system as in claim 11 in which the first processing chamber includes a second input port to accept a catalyst to furthers the chemical reaction in the first chamber.

17. A low pressure trapping system as in claim 16 in which the catalyst is selected from the group consisting of oxygen, water, alcohol, and ammonia.

18. A low pressure trapping system as in claim 11 in which a hollow transparent connector is operatively connected to the input port of the second processing chamber, whereby a visual indication of material collected at the transparent connector shows that there is a problem at the upstream flow of the cold trap.

19. A low pressure trapping system as in claim 11 in which a hollow transparent connector is operatively connected to the output port of the second processing chamber, whereby a visual indication of material collected at the transparent connector shows that there is a problem at the downstream flow of the cold trap.

20. A low pressure trapping system as in claim 11 in which the second processing chamber further comprises a drain port to collect the waste material.

Abstract

A visual indicator cold trapping system is provided to allows the visual inspection of the adequacy of a cold trap. The cold trapping system includes a hollow transparent connector operatively connected to the input of the cold trap whereby a visual indication of material collected at the transparent connector shows that there is a problem at the upstream flow of the cold trap. Alternatively, the cold trapping system includes a hollow transparent connector operatively connected to the output of the cold trap whereby a visual indication of material collected at the transparent connector shows that there is a problem at the downstream flow of the cold trap.

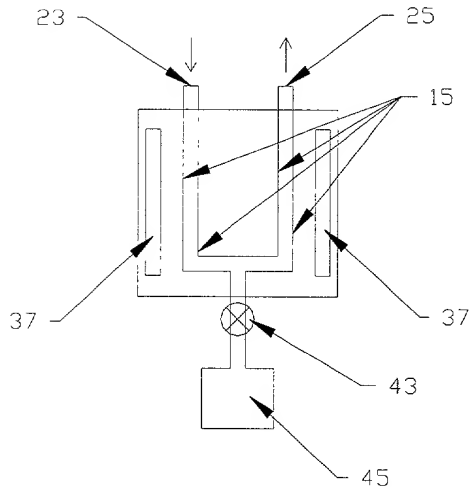
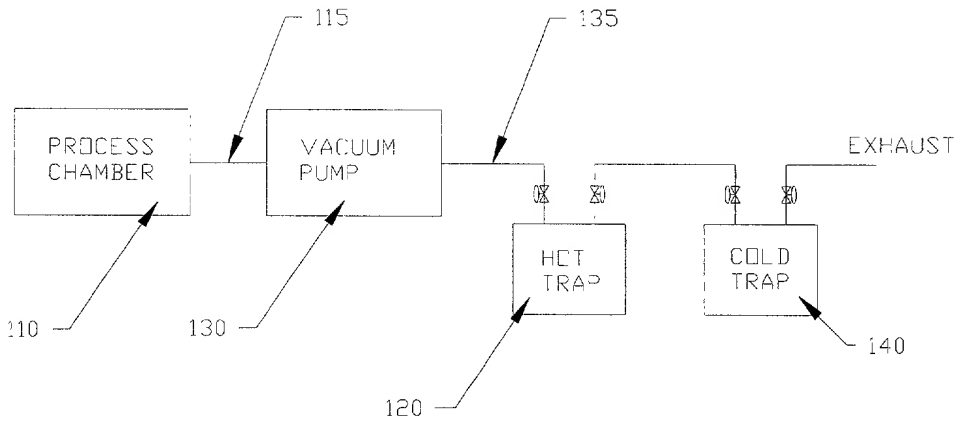


Fig 1 (Prior Art)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PROCESS CHAMBER
VACUUM PUMP
EXHAUST
HOT TRAP
COLD TRAP
110
130
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Fig 2

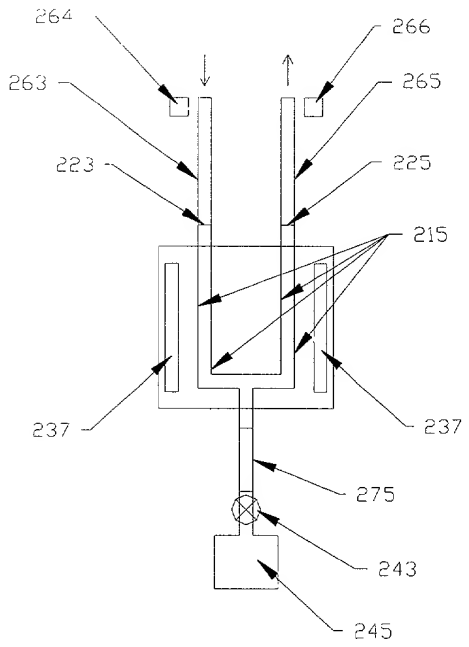

Fig 3

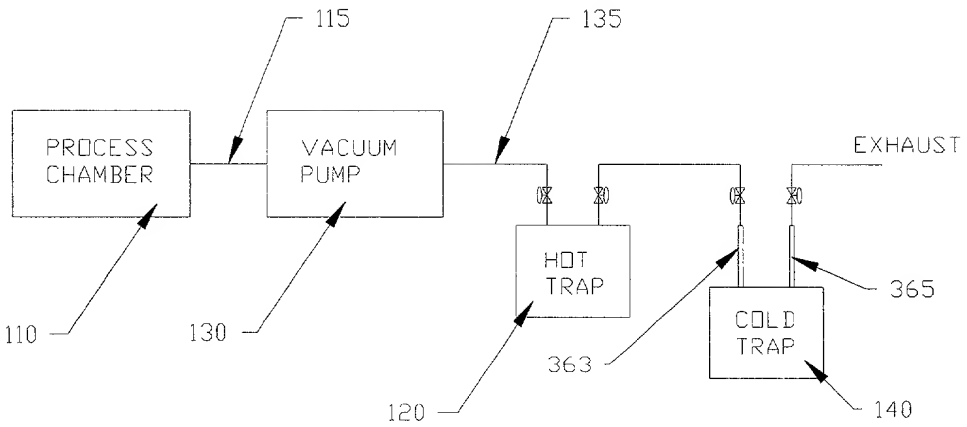
115
135
PROCESS CHAMBER
VACUUM PUMP
EXHAUST
HOT TRAP
365
COLD TRAP
110
130
363
120
140

Fig 4

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DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)

[X] Declaration Submitted with Initial Filing **OR** [ ] Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)

Attorney Docket Number	SIM014
First Named Inventor	Tue Nguyen
COMPLETE IF KNOWN	
Application Number	/
Filing Date	
Group Art Unit	
Examiner Name	

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Visual Indicator Cold Trapping System

(Title of the Invention)

the specification of which

[X] is attached hereto

OR

[ ] was filed on (MM/DD/YYYY) [ ] as United States Application Number or PCT International Application Number [ ] and was amended on (MM/DD/YYYY) [ ] (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES	NO
			[ ]	[ ]	[ ]
			[ ]	[ ]	[ ]
			[ ]	[ ]	[ ]
			[ ]	[ ]	[ ]

[ ] Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto:

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)	
		[ ] Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

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DECLARATION — Utility or Design Patent Application

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number *(if applicable)*

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: ☐ Customer Number [ ] → *Place Customer Number Bar Code Label here*
OR
☐ Registered practitioner(s) name/registration number listed below

Name	Registration Number	Name	Registration Number

☐ Additional registered practitioner(s) named on supplemental Registered Practitioner Information sheet PTO/SB/02C attached hereto.

Direct all correspondence to: ☐ Customer Number or Bar Code Label [ ] *OR* ☒ Correspondence address below

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon

Name of Sole or First Inventor: ☐ A petition has been filed for this unsigned inventor

Given Name (first and middle [if any])	Family Name or Surname
Tue	Nguyen

Inventor's Signature						**Date**	6/7/00
Residence: City	Fremont	**State**	CA	**Country**	USA	**Citizenship**	USA
Post Office Address							
Post Office Address							
City		**State**		**ZIP**		**Country**	

☒ Additional inventors are being named on the 1 supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto

Please type a plus sign (+) inside this box → [+]

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DECLARATION

ADDITIONAL INVENTOR(S)
Supplemental Sheet
Page 1 of 1

Name of Additional Joint Inventor, if any:		☐ A petition has been filed for this unsigned inventor					
Given Name (first and middle [if any])			Family Name or Surname				
Craig Alan			Bercaw				
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Name of Additional Joint Inventor, if any:		☐ A petition has been filed for this unsigned inventor					
Given Name (first and middle [if any])			Family Name or Surname				
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Post Office Address							
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City		**State**		**ZIP**		**Country**	

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